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EXAMINER	
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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 09/388,989
Filing Date: September 02, 1999
Appellant(s): COHEN ET AL.

MAILED
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GROUP 1700

Keith M. Tackett
For Appellant

EXAMINER'S ANSWER

This is in response to the brief on appeal filed January 26, 2004, which was in response to the final rejection dated October 22, 2003 not December 22, 2003.

(1) Real Party in Interest

A statement identifying the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

Appellants state that they know of none.

(3) Status of Claims

The statement of the status of the claims contained in the brief is correct.

(4) Status of Amendments After Final

The amendment after final rejection filed on 4/21/2003 has been entered.

(5) Summary of Invention

The summary of invention contained in the brief is deficient because it directs a significant amount of discussion to features that have no necessary relationship to the claims as written, especially the broadest. For example, appellants start their summary with a discourse on native oxides, but claim 1 processes a patterned dielectric layer, where the presumed substrate is unspecified, and dielectric is generic for materials that may be polymeric or inorganic, thus there may not even be the possibility of any native oxides being present to cause problems applicant discusses being solved. Therefore applicants' summary is directed to significantly narrower limitations than they have claimed.

(6) Issues

The appellant's statement of the issues in the brief is substantially correct. The changes are as follows: In order to simplify the issues under discussion, the rejections with Zhao et al are being dropped, and the rejection of Yoo et al, in view of Yamazaki remains.

(7) Grouping of Claims

Appellants state that all claims stand or fall together. Claim 1 is the broadest claim, hence will be considered representative of claims as a whole.

(8) Claims Appealed

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) Prior Art of Record

The following is a listing of the prior art of record relied upon in the rejection of claims under appeal.

5,203,957	YOO et al	4-1993
JP 56-155,526	YAMAZAKI et al	12-1981

(10) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 3-4, 6, 8-14, 17-23 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yoo et al, in view of Yamazaki (JP56-155,526).

After patterning a dielectric layer, Yoo et al teach two plasma etching steps (which can be considered to include cleaning), before metallizing where a Ti/TiW (barrier) layer may be deposited before the Al metalization. First an Ar plasma etch (1 or 2 minutes) with exemplified RF power of 400W in a magnetic field of 50 Gauss, which <u>smoothes sharp corners</u> on the patterned dielectric layer and where metal coverage is taught to improve with Ar sputter times in Example 1. There may then follow a <u>reactive ion etch</u> or less than about 60 seconds, where <u>He plus a reactive gas</u>, (soft etch) exemplified by CF_4 or CF_3H, then remove material at the bottom of the contact openings and is taught to be required for non-silicones to decrease contact resistance, a desired quality of such deposited metal coatings. Also,

while Yoo et al teach generating plasma with an electric field, and prolonging it with a magnetic field (column 4, lines 60-63), they have no explicit discussion of the apparatus structure that produces these effects, nor is the "Applied Materials P5000 etch back chamber" used therefore in the example (column 5) further described. However, the teaching of using an electric field, and the lack of any discussion on electrodes, would suggest to one of ordinary skill that external electrodes, antenna or coils were used to create the electric field, i.e. to create the plasma. to summarize, Yoo et al teach a 2 plasma sequence, which may be considered to include cleaning, with the first plasma being an Ar plasma, the second plasma using He + a reactive gas, that is exemplified by reducing gases such as CF_4 or CF_3H, but while the second plasma may include a H-containing gas serving like functions, Yoo et al differs from applicant's claims by not consisting essentially of H_2 + He, or comprising 5% H atoms and 95% He atoms, nor giving all claimed parameters for their plasmas. While Yoo et al does not discuss aspect ratios per se, they do teach that the feature sizes etched in the integrated circuit structure are about 1μm or <u>less</u> (abstract) and teach various dielectric layer thickness from 1000 Å to 10,000 Å (column 3, line 63; column 4, line 18), with the example making contact openings of 0.7 μm in dielectric layer of 7500 Å + 1000 Å = 8500 Å, thus effectively teaching aspect ratios as claimed due to these dimensions.

The English abstract of Yamazaki teaches cleaning a semiconductor substrate with an insulting surface with plasma of hydrogen and inactive gas, in preparation for metal disposition, with the translation supplying more relevant details. In the translation, teachings of cleaning substrates, inclusive of those with insulating surfaces and semi-insulating (i.e. semiconductive) are found in claims 3-4 (pages 2-3); Figures 2 described on page 9, paragraph 4 (bridging to page 10); page 11 in implementation 3; etc. Plasma cleaning of this insulating surface (or semiconductors, such as Si) using a reducing atmosphere of H_2, or H_2 mixed with He or Ar, in order to remove dirt and impurities, including –OH groups, water and absorbed oxygen, prior to disposition of metal on the surface is taught. See claims 1-2 on p.2; Fig.1; page 3, Section 3- page 4, 2nd full paragraph; page 5, lines 5-9; page 6, last paragraph-page 7, 1st full paragraph.

Note on page 8, lines 5 + of the translation, it is taught that since the surface is clean, it is physically active to the metal vapor deposition that is performed, and metals including, but not limited to Al or Ti (page 8) are deposited after taught H_2+He plasma cleaning.

It would have been obvious to one of ordinary skill in the art to employ the active reduction gas H_2 in the process of Yoo et al, because Yamazaki et al shows that H_2+ He plasma is analogously used to prepare insulting surfaces for metal deposition, where like metal may be deposited (Yoo et al, column 5, lines 14-23, Ti, TiW, Al), so one of ordinary skill would have expected effective equivalent results, with the deposition surfaces noted to have been activated for the metal deposition by the H_2+He plasma treatment thus providing further motivation, since metallization of insulating surfaces is a goal of Yoo et al, and as the process is taught to work for cleaning insulating or semi-insulating (i.e. semi-conducting) or Si as in claim 3 or page 4, its effectiveness for cleaning and preparing both the dielectric and the exposed underlying Si substrate in Yoo et al is demonstrated.

Use of alternative gases known and shown to have analogous and equivalent effects in analogous situations would have provided motivation for one of ordinary skill in the art to substitute those gases or materials, since the prior art has demonstrated the effectiveness of the alternative. In Yoo et al's process, note that while column 5, lines 3-13 discuss the "soft reactive in etch" (CF_4/He) as effecting reduced contact resistance, this is consistence with Yamazaki et al's effect of removing impurities that will effect the deposit, its adherence, and its purity, hence contact resistance. For these reasons, substitution of H_2 for the CF_3H or CF_4 reducing gas of Yoo et al, would have been obvious and motivated, as providing effects desired by and consistent with the teachings of Yoo et al for effecting metallization.

(11) Response to Argument

Appellants argue that the examiner has not provided motivation and reasonable expectation of success, and that the motivation must come from the prior art (page 5 Brief). However as seen above, motivation was repeatedly demonstrated, with teachings of all references reciting related effects of the

reactive plasma etching process. The references need not describe their effects in exactly the same language or wording, as one of ordinary skill would be able and expected to understand the relationships or equivalence of the results and effects. On page 6 of their Brief, appellant's suggest that the examiner is picking and choosing random elements, however there is nothing random about exchanging one reducing gas containing H, i.e. CF_3H (trifluoromethane) for another, H_2, where both have been shown by the art to positively improve the quality of sequentially deposited metal on the plasma treated surface of like materials. Nor do the taught benefits of the H_2 + inert gas plasmas come from appellant's specification as implied by their allegations of hindsight, but from the secondary reference.

Appellants assert on page 7 of their Brief that substitution of H_2 for the exemplary fluorocarbons would render Yoo et al unfit for their intended purpose, however the intended purpose of Yoo is NOT Si etching, but metallization of the multi-layer patterned surface (i.e. patterned Si oxide or BSG on Si, where resists were employed in the patterning steps), where the exposed Si is noted to need the soft etch treatment to enable desired contact resistance. As noted by appellant the exemplary soft etch was said to remove a very thin silica surface, hence this will effectively and inherently remove any –OH or oxidation contamination present on these surfaces and left from previous processing, since what the surface they are attach to is being removed. Yoo et al is not interested necessarily in removing the Si pre se, but improving the contact resistance, hence the interface, as would have been recognized by anyone of ordinary skill in the art.

Yamazaki further shows the importance of plasma cleaning both insulating and semiconductor (Si) surfaces for analogous metalization, plus the effectiveness of H_2 + He plasma treatment of semi-conductor devices, including those with insulating coating thereon, for improving surface characteristics for subsequent coatings of pure metal (page 4^+, translation), via removal of absorbed gases and oxidation. Yamazaki also notes that this treatment positively effects the bonding on semi-conductive surfaces such

as Si, hence is consistent with the intent of Yoo et al, so that the purpose of the soft etch steps would have been expected to be satisfactorily met with the substitution of H_2 for reactive gases of Yoo et al.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Marianne L Padgett

MARIANNE PADGETT
PRIMARY EXAMINER

Appeal Conferences
November 16, 2004

M.L. Padgett/dh
October 21, 2004

November 15 & 16, 2004

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